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Spatial aspects of recruitment behaviour of firms: an empirical investigation

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Abstract. It is widely recognized that employers' hiring standards and spatial search radius are closely linked to their recruitment decisions. A strategy to identify the right people in the right place may save firms a substantial amount of effort and financial resources. Unfortunately, economic theory has often neglected this item when dealing with spatial search and recruitment issues. In this paper firms' recruitment strategies and channels of recruitment are addressed in relation to the spatial search radius for new employees. The spatial radius is linked to the employer's attempt to convey the vacancy-related information to a targeted group of potential applicants, with a focus on the distribution of the distance between the location of the firm and the place of residence of the hired applicant. In this framework, a new statistical model is developed in order to investigate the impact of different recruitment strategies—which differ with respect to both the spatial search radius and the type of information used—on the probability of a match between the vacant position and an applicant located at a given distance from the firm. The model is implemented and tested by means of an extensive micro data set on the recruitment behaviour of Dutch firms. It is found that job requirements with respect to educational level and required working experience are important elements in the recruitment procedure, as they significantly affect the spatial dimension of search. Moreover, the use of interactive information through informal communication channels seems to be effective for short-distance matches, thus suggesting the relevance of local contact networks.

1 Introduction

It is generally accepted practice in personnel management that different job vacancies require different recruitment strategies. Such strategies may differ in terms of the spatial search radius involved, amongst other things. For instance, Torrington and Hall (1991, page 217) state: "The level of the labour market will vary with the type of work to be done. Graduates seeking a first post are typically likely to come from a wide area, so that the market is nationwide. The same applies to senior and many professional and middle management posts as the balance of net advantages could be sufficient to justify a move over several thousand miles. At the other extreme the market for word processor operators, telephonists, semi-skilled personnel and clerical staff tends to be a local one, with the majority of prospective employees seeking employment only within a limited geographical area. There is then a number of intermediate levels so that the catchment area of 5 - 10 miles for the clerk may become a 50 mile radius for the area sales manager. For highly specialized employment, like technologists in mineral exploration, the market is international, and in any organization apart from the smallest, there is also an Internal Labour Market".[1]

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[1] According to Doeringer and Piore (1971, pages 1 - 2) an internal labour market is "an administrative unit, such as a manufacturing plant, within which the pricing and allocation of labour is governed by a set of administrative rules and procedures. The internal labour market, governed by administrative rules, is to be distinguished from the external labour market of conventional economic theory where pricing, allocating, and training decisions are controlled directly by economic variables".

A sound foundation for the segmentation in the labour market can be found in Clark and Whiteman (1983), among others. Clark and Whiteman focus mainly on the supply side of the labour market, and, more precisely, on the search behaviour of low-skilled job-seekers. Central in their analysis is the fact that for average-wage and low-wage jobs the costs of search are borne usually by the workers. This fact reinforces the local character of the low-wage labour market, as the costs of search are lower for jobs closer to the job-seeker's place of residence. They then conclude that the place characteristics are very important in determining the job-search behaviour of agents, thus stressing the importance of spatial aspects for the outcome of the search activity.

To illustrate the economic importance of the spatial element in a firm's recruitment strategy, it may suffice to mention that new work opportunities elsewhere are often the drive for migration (see Maier, 1987; for a critical survey of the literature, see Nijkamp and Voskuilen, 1994). A second important point in this context refers to the duration of the recruitment procedure itself; addressing the correct geographical region can significantly shorten the duration of the recruitment procedure (Rogerson, 1987). Moreover, it is well known that recruitment channels have different features with respect to the geographical coverage of job search (for the effect of search channels on applicants' locations, see Saunders and Flowerdew, 1987). Thus, an intelligent choice of recruitment channel in relation to the relevant search radius may save firms a substantial amount of precious time. Another important aspect is noteworthy here, that is, the ability of each channel to reach that share of the population with the given desirable work characteristic.[2] To understand better this point, one may think of newspaper companies' marketing policies, where clearly the aim is to attract a targeted group of readers.[3]

Empirical evidence that different groups of job-seekers (for example, employed and unemployed) adopt different search strategies can be found in the literature (for example, see Blau and Robins, 1990; Kahn and Low, 1982). Blau and Robins, in their analysis of the Employment Opportunity Pilot Project, a data set collected on a sample of 30 000 households in the United States, reported that employed job-seekers seem to be more effective in obtaining job offers, even if they tend to use fewer search channels and to contact fewer firms. In addition, among employed searchers close to one half of all the offers are turned down, whereas for unemployed searchers the fraction of offers rejected falls to one third. The importance of the choice of the recruitment channel on the outcome of the hiring process has been stressed elsewhere (Gorter et al, 1993a), with the conclusion that the use of advertisements appears to increase the chance of hiring an already employed job-seeker when high requirements are needed, whereas the use of the labour-exchange office when low requirements are asked seems to increase the chance of hiring an unemployed job-seeker.

Most authors concerned with the spatial aspect of search have opted for a supply-side approach to the labour market. In this paper we will try to extend some of the arguments to the demand side of the labour market. In particular, our aim is to shed more light on the effect of interactions between the spatial search radius and the recruitment channels used (not necessarily the hiring channel) in recruitment practices. Therefore, after a brief survey of the relevant literature in section 2,

[2] For an empirical investigation of the impact of the employment probabilities of job seekers, of the degree of competition among applicants and of the accessibility to employment opportunities, see Mattson and Weibull (1981).

[3] Some empirical evidence on the effectiveness of job advertising policies on migration can be found in Amrhein (1986).

we will in section 3 develop a statistical model in order to investigate the impact of different recruitment strategies on the probability of a match between a vacant position and an applicant located at a given distance from the firm. In section 4 we will present and discuss some empirical estimates, and in section 5 we will offer some concluding remarks.

2 Theoretical framework

In recent economic research much attention has been paid to employers' search analysis (see Gorter, 1991; Russo et al, 1994). It is clear that in order to match a vacant position and a job-seeker, four conditions must be fulfilled; first, information about the vacancy must reach the job-seeker; second, the job-seeker must react; third, the applicant must be selected for the position; and, fourth, the selected applicant must accept the offer. It is a reasonable assumption that the larger the geographical distance at which a vacancy is posted, the larger the number of potential applicants that will be informed of the existence of the vacant position within the firm concerned. As a result one may expect a larger number of reactions and applications. However, one has to consider also a countervailing effect: the longer the distance involved, the less attractive the vacancy for potential applicants, because of the costs of moving or commuting, which are not simply monetary costs but include social costs, such as the disruption of somebody's social network and family ties. This distance-decay effect will result in a lower expected number of reactions from the remoter areas. Similarly, the attractiveness of a job offer decreases with increasing distance because of these costs (see Van Ommeren et al, 1994). In the next two subsections a more detailed exposition of the effect of spatial distance on the number of potential applicants reached and on their reactions to job offers will be provided.

2.1 Distance and quality of information

In this subsection we will first pay attention to the relationship between information and geographical coverage in job search. As far as the number of potential applicants reached is concerned, the key issue is connected to the way job-related information is spread in the labour market (for a critical review about the use of the concept of information in job-search models, see Clark, 1986; for an application to the housing market, see Turnbull and Sirmans, 1993). Most of the literature on this topic refers to the role played by information in the decision whether to migrate to another region (Amrhein, 1986; Maier, 1987; Rogerson and MacKinnon, 1982; Saunders and Flowerdew, 1987). Clearly, different search channels convey different information (Amrhein, 1985) and reach different people. According to Ralston (1983) the information conveyed by the various channels stems from two possible origins: *source information* and *interactive information*. Interactive information is defined as interpersonal communication between recent migrants (for example, persons already employed in the firm) and those remaining in the region of origin (for example, unemployed relatives or friends). Source information represents a direct flow of information from agencies or employers to a group of potential employees. Source information is characterized as being impersonal, one-way oriented, able to reach a large number of potential applicants quickly, and capable of being directed. The initiative of supplying this type of information rests with the employer. Interactive information is characterized as two-way oriented and unable to reach a large number of candidates in a short time period. However, interactive information is dependent on the agents' social network. In order to transmit this type of information both the sender and the receiver must share the same contacts. This will result in a

less controllable message. It is easy to see a parallel between the type of information provided and search channels used. In fact, an informal search channel basically conveys interactive information, whereas formal recruitment channels (such as advertisements) convey mainly source information. Rogerson and MacKinnon (1982) incorporate both types of information in their model of migration; they conclude that selective advertising campaigns—with regard to the source used and the information conveyed—may aid in reducing regional inequalities.

The possible implications for recruitment are: first, the further away the vacancy is posted the larger the number of potential applicants that may be informed about the opening; second, source and interactive information have different degrees of reliability and they affect in a different way the potential applicants' decision whether or not to react to the job notification. Thus the choice of both the geographical search radius and the type of information used will influence the size and the composition of the accessible pool of applicants (for an original analysis of the spatial aspect of the provision of job-related information, see Gorter, 1991). Three cases have been found in which spatial barriers prevent job-seekers from finding vacant jobs (Gorter, 1991): (1) job-seekers' preferences (even if searchers know about vacancies in other regions, they do not apply to these firms because they are not willing to move); (2) information barriers [a mismatch occurs between the media used by searchers and those used by employers to spread information (the mismatch may be deliberate on the employer's part)]; (3) employer's preference (applications from candidates beyond a certain radius are not accepted because employers want to hire an applicant who lives close to the firm, as the recruitment of a 'long-distance' applicant may entail high costs for the employer in terms of allowances for commuting or relocation costs). The existence of these three barriers will prevent the occurrence of the match.

2.2 Reactions to vacancy notification, and job-seekers' behaviour

We will now address the issue of the behavioural response of job-seekers to vacancy notifications. Once a job-seeker is informed of the existence of a vacancy, he or she must decide whether or not to apply for it (and to react to the vacancy notification) and, in the case of being offered the vacant position, whether or not to accept it.

These decisions are, amongst others, also based on considerations about the cost of commuting involved in terms of both time and money. In order to investigate the spatial dimensions of job-seekers' search, Rogerson (1982) reformulated the basic job-search model in a geographical context. The basic assumptions of the model are given in Lippmann and McCall (1976). The simplest extension of this approach is to associate with each region a wage distribution independent from the wage distribution in all other regions. The cost function then becomes dependent on the distance between the region of origin and the region of destination. For each origin–destination pair (i, j) we may define a reservation wage, ξ_{ij}, determined in the usual way (Lippmann and McCall, 1976). This type of model has been developed to explain discrepancies between spatially disjoint local or regional labour markets. The issue of interest in this paper, however, is the radius at which vacancies are posted, and how the commuting costs involved affect the acceptance probability of job-seekers. In order to pursue this issue, we will follow a slightly different approach from that of Rogerson (1982).

The spatial issue in a job-search framework can be viewed from a different perspective (Rouwendal and Rietveld, 1994): the wage of all jobs is assumed to be the same, so that the commuting distance is the only discriminating item the job-seeker has to face. In this model the searcher will evaluate the job offers he or she

receives on the basis of the wage offered minus the commuting costs (commuting costs are an increasing function of the commuting distance). In this way a reservation distance, ζ, can be determined; the stopping rule is, then, the following: accept any offer that involves a commuting distance τ, such that $\tau < \zeta$; otherwise, continue searching. The implication for recruitment is that the longer the commuting distance (the distance between the firm and the residential location of the applicants) the less likely it is the job-seekers will react.

So far, geographical distances have played a prominent role in explaining migration. In this context the variable distance is used as a proxy for transportation costs (commuting costs), psychic costs, and uncertainty (Greenwood, 1975). In a paper similar to that of Rouwendal and Rietveld, Maier (1987) derives a maximum distance beyond which search is worthless. This cutoff distance is influenced by the costs of commuting or migration. In this approach, the individual optimal strategy is to label jobs by their search cost and to canvas the jobs in increasing order of search costs.

Clearly, the above are supply-side approaches to the labour market. In the next section we will take a demand-side approach by investigating the effects induced by the recruitment procedure on the recruitment distance.

3 A model of spatial search and channel use

Through the statistical model proposed in this section we aim to estimate the joint distribution of the commuting distance of hired applicants and of the first search channel adopted, given the vacancy characteristics. We can rewrite the joint distribution in terms of a conditional probability, p; the model then obtained has the following structure:

$$p(\tau, \iota) = p(\tau|\iota)p(\iota)\,, \tag{1}$$

where ι is the search channel selected. The first probability on the right-hand side of equation (1) describes the whole recruitment procedure; the arrival of candidates, survival in selection, and acceptance of possible job offers. It will be discussed in more detail in section 3.1. The second probability on the right-hand side concerns the choice of the first search channel and, consequently, of the type of information to spread. This crucial choice will affect the number and type of applicants who may react to the information, as different channels can reach different segments of the population. The choice of search channel, in particular of the first search channel, has recently been discussed in the literature (see Gorter et al, 1993b; Russo et al, 1994). Consequently, we will not focus on estimation of the second probability of the right-hand side of equation (1), and hence our results must be considered conditional on the choice of the first and subsequent recruitment channels (the search strategy adopted).

3.1 The recruitment procedure

Let us formulate the probability of a match at distance τ as follows:

p(match between applicant and vacancy at distance τ | channel used) =
  p(applicant is reached at distance τ | channel used)
    × p(applicant reacts from distance τ | applicant is reached, channel used)
    × p(applicant is selected | applicant is reached and reacts, channel used)
    × p(applicant accepts offer at distance τ | applicant is reached, reacts, and is selected, channel used).

A direct estimation of this model would be possible if all relevant data on vacancy and applicants' characteristics were available. However, in the data set at our

disposal there is hardly any relevant information on the characteristics of the hired applicant and no information at all on the characteristics of rejected applicants. Consequently, we have to formulate some assumptions in order to implement the empirical estimation of the model. First, we will denote the fraction of potential applicants reached at distance τ when channel ι is used by $N_\iota(\tau)$; it will be used to measure the reaction probability, $\nu_{\tau\iota}$, the probability that an applicant will react from distance τ when strategy ι is used. We will suppose that the features, z, of potential applicants are distributed according to a distribution density of features, $f(z)$, that does not depend upon location. Thus in all locations the share of agents with a given qualification (that is, those already employed, those unemployed, and school-leavers) is constant. The joint density of agents approached [$g(\tau)$] and features of potential applicants is given by $g(\tau)f(z)$.

The next step is the formulation of the response of the candidates approached. The probability that the job-seeker (js) ϕ with features z at a distance τ from the firm reacts to the vacancy (γ) notification when channel ι is used is $w_{\phi\gamma\iota}(\tau)$. The probability that the job-seeker ϕ will accept when the vacancy γ is offered, when channel ι is used, will be denoted by $q_{\phi\gamma\iota}(\tau)^{\text{js}}$. The probability that the employer (emp) accepts candidate ϕ at distance τ for vacancy γ, when ι is the strategy adopted is $q_{\phi\gamma\iota}(\tau)^{\text{emp}}$. Thus the probability, $h_{\phi\gamma\iota}(\tau)$, of a match between applicant ϕ and vacancy γ at distance τ, when channel ι is the hiring channel, becomes

$$h_{\phi\gamma\iota}(\tau) = N_\iota(\tau)w_{\phi\gamma\iota}(\tau)q_{\phi\gamma\iota}(\tau)^{\text{emp}}q_{\phi\gamma\iota}(\tau)^{\text{js}} . \tag{2}$$

The model in this formulation still can not be estimated with the data set at our disposal; therefore, some more simplifying assumptions have to be made. We will make the following four additional assumptions.

(a) The probability that an applicant is reached is assumed to be a function of the vacancy characteristics $\boldsymbol{x}_\gamma$ (taken here to be the importance of the vacancy for the firm concerned), and of the status, z_ϕ, of the applicant; in doing this we stress the effect of differences in the search intensity between job-seekers of different status (employed, unemployed, and school-leavers) [in the present paper we will not deal with positive search externalities as analyzed by Pissarides (1984)].

(b) The probability that a candidate once reached will react is assumed to be a function of the vacancy characteristics (the attractiveness of the vacancy), of the status of the candidate (the pressure on the candidate), and of the distance between the firm and the place of residence of the applicant (Blau and Robins, 1990).

(c) We will assume that employers search sequentially; that is, the firm will screen and select the applicants one by one, as they arrive. For each applicant the employer will check whether its minimum level of productivity is met by the candidate. Thus, the employer will accept candidate ϕ for vacancy γ, if his or her productivity is greater than the reservation productivity for that vacancy. The probability the employer accepts the candidate can be thought of as a general function of the vacancy characteristics (via the reservation productivity, in terms of the productivity level and the distance), of the applicant's characteristics (signals of his or her productivity), and the distance between the firm and applicant's place of residence, that is $q_{\phi\gamma\iota}^{\text{emp}} = q_\iota(\tau|\boldsymbol{x}_\gamma z_\phi)$.

(d) The probability that the candidate will accept the offer will again be assumed to be a function of the attractiveness of the vacancy. The status of the candidates in this case will play a different role, for to accept a new job involves different costs for employed compared with unemployed job-seekers. Employed job-seekers will, on accepting the job offer, bear pension losses, losses of fringe benefits, and psychic

costs, such as learning a new job and familiarizing themselves with new colleagues and a new institution (see Hey and McKenna, 1987).

Under these conditions, equation (2) becomes

$$h_{\phi\gamma\iota}(\tau) = h_\iota(\tau|\boldsymbol{x}_\gamma, z_\phi) = N_\iota(\tau|\boldsymbol{x}_\gamma, z_\phi)s_\iota(\tau|\boldsymbol{x}_\gamma, z_\phi)\,, \tag{3}$$

where N represents the percentage of the population reached by the vacancy notification, and s represents the reaction and acceptance probability of both the employer and the job-seekers ($s = wq^{\text{emp}}q^{\text{js}}$).

In the next section we will formulate the appropriate likelihood function for the reduced-form model presented.

3.2 The likelihood function

In order to derive the likelihood function, a set of assumptions on the functional form of the density function has to be made. The first assumption is that the population is uniformly distributed over space; in this case, the percentage of addresses reached by the employer at a radius τ is given by

$$\left.\begin{aligned} N_\iota(\tau|\boldsymbol{x}_\gamma, z_\phi) &= \delta_1 2\pi\tau(\boldsymbol{x}_\gamma, z_\phi)\,, \\ \tau(\boldsymbol{x}_\gamma, z_\phi) &= (\boldsymbol{x}_\gamma^{\mathrm{T}}\alpha_\gamma + z_\phi^{\mathrm{T}}\alpha_\phi)\tau\,, \end{aligned}\right\} \tag{4}$$

where δ_1 is chosen such that the integral across all τ is equal to 1; and α_γ and α_ϕ are the parameters to be estimated.

Second, the reaction function is assumed to be a function of the commuting distance τ and of a vector of personal characteristics z_ϕ. A possible specification is then

$$s_\iota(\tau|\boldsymbol{x}_\gamma z_\phi) = \delta_2 \exp[(\boldsymbol{x}_\gamma^{\mathrm{T}}\alpha_\gamma + z_\phi^{\mathrm{T}}\alpha_\phi)\tau]\,, \tag{5}$$

where δ_2 is again an integration constant.

The contribution to the likelihood function of a single observation is given by

$$h_{\phi\gamma\iota} = \delta 2\pi(\boldsymbol{x}_\gamma^{\mathrm{T}}\alpha_\gamma + z_\phi^{\mathrm{T}}\alpha_\phi)\tau\exp[(\boldsymbol{x}_\gamma^{\mathrm{T}}\alpha_\gamma + z_\phi^{\mathrm{T}}\alpha_\phi)\tau]\,. \tag{6}$$

In this context the parameters α should be interpreted as the effects of vacancy characteristics on the probability of a match between the vacancy and a job-seeker originating from a distance τ. As can easily be seen, equation (6) has the form of a gamma distribution with parameter $r = 2$ [see equation (7)].

The rationale behind the assumption about the functional forms of the densities can be found in an earlier paper (Rouwendal and Rietveld, 1994) in which it was stressed that, for a survey among Dutch households, the observed distribution of commuting distance is skewed and bell-shaped, such as curve A in figure 1. Curve A

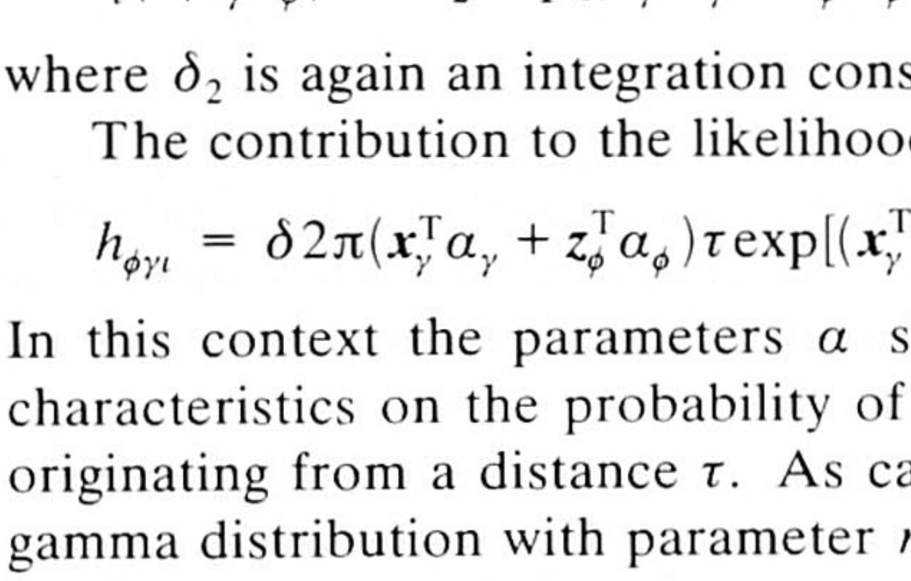

Figure 1. The distribution of commuting distances (A), the reaction curve (B), and the number of potential applicants reached (curve C).

can be thought of as the product of two functions or effects [as is h in equation (3)], one shaped like reaction curve B and the other shaped like curve C, representing the number of potential applicants reached (see figure 1). Curve B can be conceived of as a representation of the acceptance behaviour of agents reached, whereas curve C gives the size of the pool of potential applicants reached as the spatial search radius increases.

4 Empirical results

The statistical model developed in the previous sections will be applied to data on job vacancies in the Netherlands. The aim of the analysis is to investigate the effects of vacancy and personal characteristics on the probability of a match at a distance τ. The data set is the result of a survey held in 1986 on employers' recruiting behaviour. The data set contains microdata about 759 filled vacancies (for a more detailed description of the data set, see Gorter, 1991). Employers were asked about the characteristics of the vacant position, the characteristics of the hired applicants [such as educational level, previous labour-market position (status), and distance from the firm, that is, the distance from the applicant's place of residence to the firm's location], the first and subsequent recruitment channels used, the actual hiring channel, and the importance attached to certain aspects of the recruitment procedure (questions were asked on the importance of costs, effort, speed in providing candidates, motivation, and compliance with the hiring standards in the recruitment procedure). The answers to the set of questions on recruitment procedure were used in order to capture the impact of different personnel management strategies on the distribution of commuting distance. With regard to the choice of recruitment channels, the data set distinguishes between informal channels [internal recruitment, referral from own personnel, and self-initiated applications ('walk-ins' and 'write-ins')], advertisement, labour-exchange offices, and the residual category 'other' (including school recruitment and temporary placement offices). The exogenous demand-side variables (x) included in the model can be subdivided into three groups, namely variables related to the firm's personnel management strategy, variables related to the firm's characteristics, and variables related to the vacant position.

The reduced-form model that will be adopted here concerns the spatial dimension of search. Three possible specifications will be discussed, the first making use of a gamma function with a fixed parameter, as suggested by equation (6), the second allowing the fixed parameter of the gamma distribution to vary freely, and the third adopting a lognormal distribution, as seems to be suggested by the data. The choice for these distributions was instigated by the observation of the distribution of the recruitment distances in our data set (see figure 3), but there is a theoretical preference for a gamma distribution (Rouwendal and Rietveld, 1994). In order to gain some insight into the data concerned we will offer next some descriptive statistics.

4.1 Some descriptive statistics

Before turning to a more in-depth statistical analysis, let us now present some descriptive results in order to obtain a general idea of the pattern of recruitment distances in relation to the use of different hiring channels.

The average recruitment distance for the informal channel appears to be approximately 17 km [see figure 2(a)], 23 km for advertisements [see figure 2(b)], 11 km for the labour-exchange office [figure 2(c)], and 17 km for the residual category [including school recruitment and temporary placement offices; see figure 2(d)].

The figures show the tendency of advertisements to have a wider geographical coverage. Moreover, the statistics seem to confirm the local character of the labour-exchange office, which on average appears to recruit at the shortest distance. As a further remark, one may notice that the advertisement has the longest average recruitment distance, even when no distinction is made between advertisements in a local newspaper and advertisements in regional and/or national newspapers.

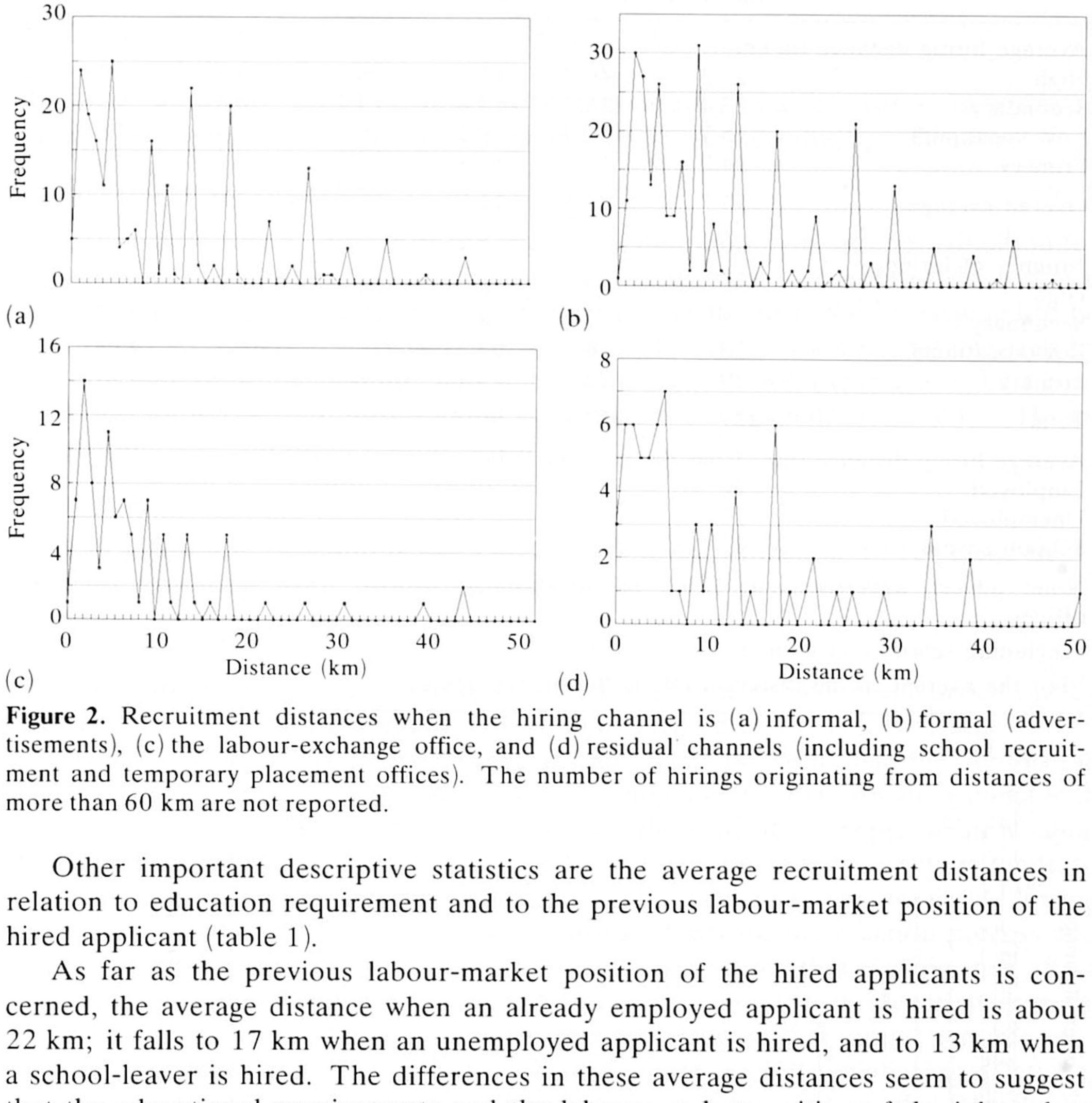

Figure 2. Recruitment distances when the hiring channel is (a) informal, (b) formal (advertisements), (c) the labour-exchange office, and (d) residual channels (including school recruitment and temporary placement offices). The number of hirings originating from distances of more than 60 km are not reported.

Other important descriptive statistics are the average recruitment distances in relation to education requirement and to the previous labour-market position of the hired applicant (table 1).

As far as the previous labour-market position of the hired applicants is concerned, the average distance when an already employed applicant is hired is about 22 km; it falls to 17 km when an unemployed applicant is hired, and to 13 km when a school-leaver is hired. The differences in these average distances seem to suggest that the educational requirements and the labour-market position of the job-seeker play an important role in our model.

Now let us turn to the distribution of the distance from the job-seeker's place of residence to the firm posting the vacancy (figure 3). At first sight it seems that the distance is distributed according to an exponential distribution; but a closer look reveals that the distribution of the distances among hired applicants is quite similar to the expected distribution as shown in figure 1. As can be noticed from figure 3, the number of hirings increases rapidly up to 2 km, peaks again around 5 km, and then steadily decreases as the distance increases. This is the reason why for the specification of our model we adopted first, as a benchmark, the gamma distribution with $r = 2$, a specification which gives the typical skewed bell-shaped curve, and,

next, the lognormal distribution[4] (see section 4.2 below). In order to take into consideration the fact that an exponential distribution may also perform well, we allowed, as a further step in our estimation, the parameter r to vary freely.

Table 1. Some descriptive statistics.

Educational requirement	Hiring channel					Total[b]
	informal	advert	LEO	TPO	other[a]	
Average hiring distance (in km)						
High	21.3	46.7	11.3	56.6	19.1	37.6
Secondary	23.4	22.7	14.6	13.2	38.4	22.5
Low vocational	13.7	11.0	9.2	8.0	6.5	11.2
Primary	14.2	11.9	17.8	20.7	4.0	14.3
Overall average	17.0	23.1	11.1	16.9	17.0	19.0
Number of hirings						
High	26	72	6	4	8	116
Secondary	55	137	18	10	9	229
Low vocational	118	116	63	16	19	332
Primary	30	22	9	6	1	68
Total	229	347	96	36	37	745
Average hiring distance (km) from the previous labour-market position						
Employed	22					
Unemployed	17					
School-leavers	13					

Note: advert, advertisement; LEO, labour-exchange offices; TPO, temporary placement offices.

[a] Including school recruitment.

[b] For the average hiring distance, this is the overall average.

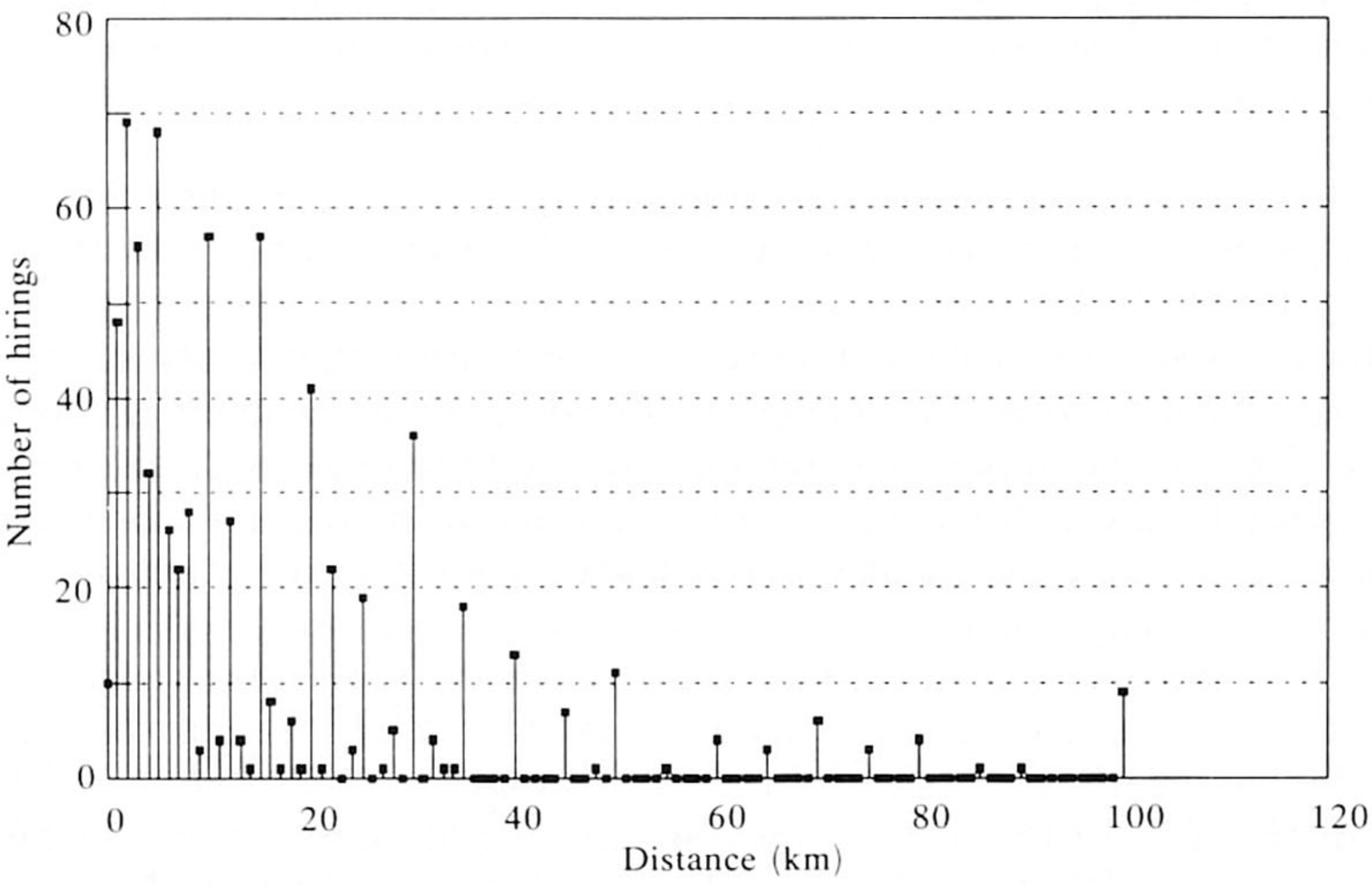

Figure 3. The frequency distribution of the distance from the hired applicant's place of residence to the firm posting the vacancy. The number of hirings originating from distances of more than 100 km are not reported.

[4] The data may suggest the use of the lognormal distribution, but this density function does not, however, correspond to equation (6); it may at best be considered as an ad hoc specification.

Now that we have given the descriptive results, we will present next the maximum likelihood estimates for the three models.

4.2 Estimation of the spatial search radius

The results for the estimates of the three above-mentioned models are given in table 2. We will begin with the gamma distribution; its probability density function, $f^{\Gamma}(\tau)$, is given by

$$f^{\Gamma}(\tau) = \frac{\lambda^{r}}{\Gamma(r)}\,\tau^{r-1}\exp(-\lambda\tau), \qquad \lambda > 0, r > 0\,. \tag{7}$$

We have allowed λ to be a function of the vacancy characteristics; in order to satisfy the condition $\lambda > 0$ we have adopted for λ the following specification:

$$\lambda = \exp(\boldsymbol{x}_{\gamma}^{\mathrm{T}}\alpha_{\gamma} + \boldsymbol{z}_{\phi}^{\mathrm{T}}\alpha_{\phi})\,.^{(5)}$$

Let us now turn to the use of the lognormal distribution as an approximation for equation (6). The use of this distribution implies that the logarithm of the distance between the hired applicant's place of residence and the firm will be assumed to be distributed according to a normal distribution. This distribution is characterized by two parameters: μ, the average, and σ, the variance. We will assume σ to be a constant and we will specify μ as a linear combination of explanatory variables. Hence we obtain

$$\mu = \boldsymbol{x}_{\gamma}^{\mathrm{T}}\alpha_{\gamma} + \boldsymbol{z}_{\phi}^{\mathrm{T}}\alpha_{\phi}\,.$$

The lognormal distribution has a probability density function, $f^{\mathrm{LN}}(\tau)$, given by

$$f^{\mathrm{LN}}(\tau) = \frac{1}{\tau(2\pi)^{1/2}\sigma}\exp\left[-\frac{(\ln\tau-\mu)^{2}}{2\sigma^{2}}\right]. \tag{8}$$

The estimations (aggregated over all recruitment channels) have been carried out by means of the maximum likelihood method implemented by the Gauss routine.

By comparing the log-likelihoods, it can easily be seen that the fit for the gamma distribution with a flexible value of r is much better than for the gamma with a fixed value of r. When r is allowed to vary, the estimate is approximately equal to 1 (with a significant gain in likelihood), so that the gamma function tends to coincide with an exponential distribution.[6] This fact gives rise to the following interpretation: given the linear functional forms adopts for the reaction process and the exponential forms for the acceptance process, it seems that the distance effect has an impact on the acceptance process but seems absent in the reaction process.

As far as the search strategy is concerned, we assumed that interaction information is used when only the informal channels (such as self-initiated applications, external relations, referral by own personnel) have been used by the firm during recruitment. However, source information is assumed when the firm has used only formal search channels in recruitment (such as labour-exchange office, temporary placements offices, advertisements, school placements). The mixed strategy is assumed when the firm has made use of informal and formal search channels. As expected, there is a strong positive effect of the educational level required on the average distance between the hired applicant's dwelling and the firm, thus involving a higher

[5] It is important to note that the expected value of the lognormal specification is $\exp[(\mu+\sigma^{2})/2]$, where μ is the average and σ is the variance, whereas the expected value of the gamma distribution is r/λ; thus, we will actually estimate $\lambda^{-1} = \exp(\boldsymbol{x}_{\gamma}^{\mathrm{T}}\alpha_{\gamma} + \boldsymbol{z}_{\phi}^{\mathrm{T}}\alpha_{\phi})$.

[6] This means that the upward sloping part of distribution curve A in figure 1 appears to be of negligible relevance according to our estimates. Moreover, the result holds true for all the estimations carried out.

Table 2. Determinants of average recruitment distance.

Variable	Distribution		
	lognormal	gamma ($r = 2$)	gamma (r free)
Constant	1.36 (0.33)**	1.32 (0.21)**	2.00 (0.29)**
Personnel management			
effort	0.02 (0.10)	−0.11 (0.06)	−0.11 (0.10)
motivation	0.04 (0.22)	0.15 (0.14)	0.15 (0.25)
speed	−0.16 (0.10)*	−0.19 (0.07)**	−0.19 (0.09)*
cost	−0.12 (0.10)	−0.16 (0.06)**	−0.16 (0.10)*
standards	0.15 (0.19)	0.31 (0.11)**	0.31 (0.15)*
Search strategy[a]			
interaction information	−0.25 (0.11)**	−0.09 (0.08)	−0.09 (0.11)
source information	0.00 (0.09)	0.01 (0.05)	0.01 (0.03)
Vacancy characteristics			
permanent position	0.07 (0.12)	−0.05 (0.09)	−0.05 (0.11)
full-time job	0.32 (0.13)**	0.30 (0.08)**	0.30 (0.12)**
Required education			
extended vocational, and high	0.88 (0.19)**	0.71 (0.13)**	0.72 (0.20)**
secondary	0.37 (0.17)**	0.29 (0.12)**	0.29 (0.18)*
low vocational	−0.13 (0.16)	−0.31 (0.10)**	−0.31 (0.16)**
Experience required			
specific	0.29 (0.11)**	0.35 (0.08)**	0.35 (0.10)**
nonspecific	−0.10 (0.17)	−0.24 (0.10)**	−0.24 (0.13)*
Age restriction	−0.15 (0.09)*	−0.19 (0.06)**	−0.19 (0.08)**
Firm characteristics			
personnel department	−0.08 (0.10)	−0.05 (0.06)	−0.05 (0.10)
large size[b]	0.40 (0.13)**	0.30 (0.09)**	0.30 (0.13)**
medium size[c]	0.26 (0.11)**	0.12 (0.08)*	0.12 (0.10)
industrial sector	−0.23 (0.12)*	−0.13 (0.07)*	−0.13 (0.11)
construction sector	0.04 (0.13)	0.10 (0.08)	0.10 (0.14)
quaternary sector	−0.16 (0.12)	0.04 (0.07)	0.04 (0.15)
Previous labour-market position			
already employed	0.13 (0.12)	0.13 (0.08)	0.13 (0.11)
unemployed	0.34 (0.15)**	0.33 (0.10)**	0.33 (0.13)**
σ	1.09 (0.03)**		
r		2	1.01 (0.05)
Log-likelihood	−2073.812	−2942.199	−2803.599
Number of observations	745	745	745

Exogenous variable	Reference group
Required education	Primary
Size of the firm	Small
Sector of the firm	Services
Personnel department	No personnel department
Required experience	No experience required
Age restriction	No age restriction
Permanent job	Temporary job
Full-time job	Part-time job
Search strategy	Mixed
Previous labour-market position	School-leavers

Note: standard errors are given in parentheses.

[a] Interaction information is interpersonal communication between recent migrants and people remaining in the region of origin. Source information is a direct flow of information from agencies of employees to a group of potential employees.

[b] Firms with more than 10 but fewer than 100 employees.

[c] Firms with more than 100 employees.

* Significant at 10% level. ** Significant at 5% level.

spatial search radius.[7] The same holds true in the case where the vacant position refers to a permanent job. As anticipated, the strong positive effect of the experience required on the distance shows up clearly here, thus confirming the idea that the higher the requirements the broader the search for a suitable candidate. Furthermore, a significant and positive effect of the size of the firm on the recruitment distance has been found; this phenomenon may be induced by the higher wages paid by larger firms[8] so that workers accept higher commuting or relocation costs (Rouwendal and Rietveld, 1994; Van Ommeren et al, 1994). The negative effect of age required on the distance may be interpreted along the same lines. Usually, young entrants in the firm receive lower wages, rending high commuting or relocation costs unbearable for the newly hired persons. The age influence may affect both parties in a match at a given distance; on the supply side, age makes a high commuting cost unbearable; on the demand side the employer may not be willing to pay relocation costs for a young employed person whose productivity has not yet been ascertained and who often is prone to quit soon (witness the abundant literature on human capital investment; among others, see Layard et al, 1992; Oi, 1962). As far as the recruitment strategies are concerned, apparently only the use of interactive information affects significantly the probability of a match at short distances. It may suggest the existence of local networks or of extended internal labour markets.

Actually, we expected source information (advertisements) to be effective for 'long-distance' matches. The absence of this effect may be ascribed to two main causes: first, no distinction was made between newspapers in which the advertisement was placed, whether it was a local, regional, national, or international newspaper; second, different recruitment channels with different spatial attitudes, such as advertisements and labour-exchange office (local attitude), were included in the same class of information (that is, source information). This outcome is confirmed by the observed differences in the recruitment distances per channel (figure 2).[9]

Concerning the previous labour-market position of the hired applicants we notice that in the case where the recruited person is unemployed a longer recruitment distance results. This may be interpreted as a supply-side effect and may be ascribed to the fact that workers already employed may be more selective in accepting a new job involving longer distances to travel, whereas unemployed job-seekers tend to be 'under pressure' and thus may be forced to accept job offers involving longer travel distances.

Next, let us turn briefly to the variables concerning personnel management strategies. The only variable that appears to be significant in all models is the one referring to the importance of the ability of the recruitment procedure to provide applicants quickly. In the case where an employer considers the speed of generating

[7] This effect may have an alternative interpretation; people recruited for highly paid jobs can afford to live out of town. Unfortunately, we cannot distinguish these cases in our data set.

[8] For the efficiency wage and insider–outside theories, see Lindbeck and Snower (1989); for a study of the existence of systematic firm-size differences in wages, see Idson (1990), Layard et al (1992), and, with special reference to the Dutch experience, see Oosterbeek and Van Praag (1993).

[9] In order to obtain further insight into the interrelationship between the use of advertisements, the spatial search radius, and hiring standards, we have rerun the models to include some cross-effects among the regressors. The only important cross-effect found is the one that refers to the use of advertisements when a high level of education is required. Thus, it appears that the use of advertisements is indeed effective for a 'long-distance' match when the educational standards required are high.

new applicants to be an important condition for recruitment, it appears that the distance at which a match occurs is shorter. This result may be interpreted along the lines of the job-search model proposed by Maier (1987), in which job-seekers apply first to vacant positions closer to their place of residence, enlarging the spread of search as closer-by matches fail to occur.

To continue, we controlled for some cross-effects between the educational experience requirements, the search strategy used (and also the specific search channel used), and the previous labour-market position, but none of these appeared to be significant (see also footnote 9). Moreover, we have estimated separately the general model for each recruitment strategy. The estimates (for the gamma specification with free r) are put together in table 3. It is immediately clear from an inspection of this table that for some determinants the three different strategies have

Table 3. Determinants of average recruitment distance for different recruitment strategies, for the gamma distribution, with r free.

Variable	Recruitment strategy[a]		
	interaction information	source information	mixed
Constant	2.13 (0.73)**	1.49 (0.61)**	1.77 (0.51)**
Personnel management			
effort	−0.11 (0.24)	0.09 (0.15)	−0.03 (0.18)
motivation	−0.11 (0.47)	0.32 (0.42)	0.11 (0.35)
speed	−0.40 (0.18)**	−0.17 (0.17)	−0.13 (0.12)
cost	0.43 (0.22)**	−0.03 (0.17)	−0.44 (0.11)**
standards	0.90 (0.39)**	0.06 (0.29)	−0.02 (0.15)
Vacancy characteristics			
permanent position	−0.09 (0.28)	0.46 (0.23)**	−0.26 (0.15)*
full-time job	−0.25 (0.37)	0.28 (0.23)**	0.59 (0.16)**
Required education			
extended vocational, and high	0.44 (0.41)	0.45 (0.32)	1.05 (0.27)**
secondary	0.37 (0.38)	0.04 (0.28)	0.63 (0.24)**
low vocational	−0.18 (0.31)	−0.62 (0.26)**	0.07 (0.22)
Experience required			
specific	−0.30 (0.27)	0.51 (0.21)**	0.43 (0.14)**
nonspecific	−0.57 (0.33)*	0.01 (0.24)	−0.37 (0.19)*
Age restriction	−0.71 (0.23)**	0.12 (0.14)	−0.28 (0.11)**
Firm characteristics			
personnel department	0.16 (0.22)	0.01 (0.17)	−0.10 (0.14)
large size[b]	0.80 (0.30)**	0.37 (0.23)*	0.27 (0.16)*
medium size[c]	0.07 (0.24)	0.48 (0.19)**	0.12 (0.14)
industrial sector	0.08 (0.30)	−0.36 (0.18)**	−0.21 (0.15)
construction sector	0.07 (0.26)	−0.36 (0.22)*	0.27 (0.18)
quaternary sector	−0.74 (0.34)**	−0.06 (0.07)	0.31 (0.15)**
Previous labour-market position			
already employed	0.35 (0.27)	−0.35 (0.21)*	0.13 (0.16)
unemployed	0.21 (0.28)	0.28 (0.24)	0.40 (0.19)**
r	1.08 (0.12)	1.14 (0.11)	1.11 (0.07)
Log-likelihood	−437.185	−959.440	−1357.793
Number of observations	127	257	361

Note: for the reference groups of the exogenous variables see table 2. Standard errors are given in parentheses.

[a, b, c] See table 2.

* Significant at 10% level. ** Significant at 5% level.

different implications for recruitment. On the one hand, some of the results such as the functional form, the size effects, the age effect, and the effect of educational and experience requirements appear to be quite robust; on the other hand, some strategy-specific features seem to be present and it is on these we will concentrate.

Interestingly, firms in the quaternary sector show different behaviour according to the recruitment strategy adopted; it appears that the use of either interaction or source information results in short-range matches, whereas the use of mixed strategies results in longer range matches (probably because of the use of advertisements). If we turn now to the source information it seems that the industrial and construction sectors generally have short-range matches; the result is probably a result of the fact that both sectors tend to rely on the labour-exchange office in order to fill their vacancies.

As already noted above, the results in table 2 on the previous labour-market position confirm our expectation about the search behaviour of these agents; in particular, already employed job-seekers seem to be more selective and to accept mainly job offers close to their place of residence, whereas the opposite holds true for unemployed job-seekers who are 'forced' to be less selective in accepting a job offer. In order to check whether different groups of job-seekers behave in different manners, we also estimated separately the gamma model with a free r parameter for each group of job-seekers (employed, unemployed, and school-leavers) (these results are available from the authors on request). The main group-specific results are as follows (we will discuss only those parameters which turned out to be significant for each group).

Let us begin with already employed job-seekers. The significant effects that distinguish this group of job-seekers from the others refer to size of firm, experience, and compliance with the hiring standards. The size of the firm and specific experience requirements tend to lengthen the range of the match. This result is strengthened when firms consider important the compliance with the hiring standards; if this is the case the search radius is lengthened. The same variables did not turn out to be significant for the other two groups of job-seekers. As far as matches that resulted in the recruitment of unemployed job-seekers are concerned, it appears that the use of interaction information results in short-range matches, whereas the effects of both full-time position and high educational requirements tend to result in longer-distance matches. Again, the fact that the vacancy posted is in the primary segment of the labour market does not have a significant influence on recruitment distance for unemployed and school-leavers. Last, let us look at the results referring to school-leavers. The main result for this specific group of job-seekers refers to the educational requirements; the higher the level of education required the longer the recruitment distance. Another significant effect is the one referring to the employer's perception of recruitment costs. If recruitment costs are considered important then the hiring distance tends to shorten; a result in line with Maier (1987).

5 Conclusions

Our empirical analysis has provided evidence of procedures believed to be common practice in personnel management. Particularly, it appears that when candidates with high standards—higher education and/or specific work experience—are needed, the spatial range of search is broadened. The same result seems to apply to the size of the firm: the bigger the size the wider the spatial search.

If we turn to the role played by the type of information used—source or interaction—it seems that source information is more effective in the search for highly qualified candidates, when longer distances are involved. Three important

aspects have been neglected so far in the present work. First, the phasing of time in the choice of the search channels and in the use of the two types of information is important, as stressed by Ralston (1983). Source information seems to be more important at the beginning of the process, whereas at a later stage, interaction information tends to become more important. People are influenced in their decisions by different communication channels at different times. This can be linked to the role of selection in recruitment. Let us illustrate this case by means of an example. Suppose a pool of applicants has been gathered by means of source information. During the selection stage both parties, employer and employee, learn about one another; in this case, hiring is the result of the timing of the two types of information: first, source information to assemble the pool of applicants, and, next, interaction information to assess the suitability of the applicants. This is in line with Torrington and Hall (1991) when they refer to recruitment as a two-way process.

Second, the role played by the degree of competition between firms (or applicants; see Rogerson, 1987) on the local labour market regarding the spatial spread of search has not yet been analyzed (although it appears that job-seekers in different labour-market positions adopted different search strategies). Nevertheless, this is also likely to be an important aspect in the search process and deserves more attention in future research.

Finally, a third possible line of research is to study the relations between recruitment distances and commuting distances. This would involve the analysis of the decision to change residence by workers as a function of the recruitment distance itself.

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